

Customer No. 27061
Confirmation No. 9964

Patent
Attorney Docket No. GEMS8081.195

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of : Patch, Sarah K.
Serial No. : 10/800,957
Filed : March 15, 2004
For : METHOD AND SYSTEM OF THERMOACOUSTIC COMPUTED
TOMOGRAPHY
Group Art No. : 3737
Examiner : Elmer M. Chao

CERTIFICATION UNDER 37 CFR 1.8(a) and 1.10

I hereby certify that, on the date shown below, this correspondence is being:

Mailing

☐ deposited with the US Postal Service in an envelope addressed to Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450

37 CFR 1.8(a)

37 CFR 1.10

☐ with sufficient postage as first class mail ☐ As "Express Mail Post Office to Addressee" Mailing Label No.

Transmission

☐ transmitted by facsimile to Fax No.: 571-273-8300 addressed to Examiner Elmer M. Chao at the Patent and Trademark Office.
☒ transmitted by EFS-WEB addressed to Examiner Elmer M. Chao at the Patent and Trademark Office.

Date: April 26, 2010

/Robyn L. Templin/
Signature

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPEAL BRIEF PURSUANT TO 37 C.F.R §41.37

Dear Sir:

This Appeal Brief is being filed in furtherance of the Notice of Appeal filed on February 25, 2010.

1. **REAL PARTY IN INTEREST**

The real party in interest is General Electric Company by virtue of the Assignment recorded May 18, 2004, at reel 014622, frame 0914.

2. **RELATED APPEALS AND INTERFERENCES**

Appellant is unaware of any other appeals or interferences related to this Appeal. The undersigned is Appellant's legal representative in this Appeal. General Electric Company, the Assignee of the above-referenced application, as evidenced by the documents mentioned above, will be directly affected by the Board's decision in the pending appeal.

3. **STATUS OF CLAIMS**

Claims 1, 2, and 4-26 are pending in the present application. In the Final Office Action dated November 25, 2009 and in the Advisory Action dated February 2, 2010, claims 1, 2, and 4-26 were indicated as being rejected under 35 U.S.C § 101, § 112, and § 103(a). Claim 3 has been cancelled.

In the Advisory Action dated February 2, 2010, the Examiner indicated that the rejections under 35 U.S.C § 101 and 35 U.S.C. § 112 were overcome. Thus, claims 1, 2, and 4-26 are currently under final rejection under 35 U.S.C. § 103(a), and the rejection of claims 1, 2, and 4-26 under 35 U.S.C. § 103(a) are the subject of this appeal.

4. **STATUS OF AMENDMENTS**

All previous amendments have been entered. Amendments submitted on January 2, 2010 were entered in the Advisory Action of February 2, 2010. Appellant has submitted no additional amendments subsequent to the Advisory Action of February 2, 2010.

5. **SUMMARY OF CLAIMED SUBJECT MATTER**

The following is a summary of the claimed subject matter of independent claims 1, 13, 20, and 24, as disclosed in the specification with supporting citations to reference numerals and page and line numbers in accordance with 37 C.F.R. §41.37(c)(1)(v).

Claim 1 calls for a method of diagnostic imaging comprising acquiring a first set of thermoacoustic computed tomography (TCT) data from a measurement surface (14, 30) of an imaging object (12). *Application*, pg. 9, lns. 15-23, and FIGS. 1 and 2. The method includes determining a second set of TCT data from the first set of TCT data for a second inadmissible measurement surface (16). *Id.*, pg. 9, ln. 25 through pg. 10, ln. 12, and FIGS. 1 and 2. The method includes reconstructing an image of the imaging object (12) based on the first set and the second set of TCT data. *Id.*, pg. 10, lns. 8-11.

Claim 13 calls for a thermoacoustic computed tomography (TCT) imaging system (20) comprising an energy source (32) configured to apply energy to an imaging object (12) to induce thermal expansion in the imaging object (12). *Id.*, pg. 8, lns. 19-26 and FIGS. 1 and 2. System (20) includes one or more sensors (14, 30) positioned at one or more respective positions and configured to acquire ultrasonic data from the imaging object (12) caused by RF energy-induced thermal expansion in the imaging object (12). *Id.*, pg. 8, ln. 28 through pg. 9, ln. 23, and FIGS. 1 and 2. System (20) includes a computer (36) programmed to derive, from the acquired data, unacquired data for the imaging object (12) for one or more locations inadmissible (16) for sensor positioning due to a positioning of the imaging object. *Id.*, pg. 9, ln. 25 through pg. 10, ln. 12, and FIGS. 1 and 2.

Claim 20 calls for a computer readable storage medium having a computer program stored thereon and representing a set of instructions that when executed by a computer (36) causes the computer to determine coefficients of a polynomial expression that is relative to a position of a transducer (14, 30) about an imaging object (12). *Id.*, pg. 10, lns. 3-6, and FIGS. 1 and 2. The computer (36) is caused to acquire thermoacoustic computed tomography (TCT) data from the imaging object (12) and, from the coefficients, determine TCT data corresponding to a desirable transducer location about the imaging object that is inadmissible (16) to a TCT transducer. *Id.*, lns. 6-8. The computer (36) is caused to generate an image using at least the TCT data determined from the coefficients. *Id.*, pg. 10, lns. 8-11.

Claim 24 calls for a method of imaging a breast (12) comprising projecting high frequency energy toward a breast (12) to induce thermal expansion of tissue in the breast (12). *Id.*, pg. 8, lns. 19-26 and FIGS. 1 and 2. The method includes receiving ultrasonic

emissions at a first set of transducer locations (14, 30) from a first portion of the breast (12) resulting from the thermal expansion and generating a first thermoacoustic computed tomography (TCT) dataset from the ultrasonic emissions. *Id.*, pg. 8, ln. 28 through pg. 9, ln. 19, and FIGS. 1 and 2. The method includes deriving a second TCT dataset from the first TCT dataset, the second TCT dataset including data for transducer locations mirrored from the first set of transducer locations. *Id.*, pg. 9, ln. 19 through pg. 10, ln. 12, and FIGS. 1 and 2. The method includes generating an image using at least the second TCT dataset. *Id.*, pg. 10, lns. 8-11.

6. **GROUND OF REJECTION TO BE REVIEWED ON APPEAL**

Whether claims 1-2, 5-9, 13, 16-19, and 24-26 are unpatentable under 35 U.S.C. 103(a) over Kruger (USP 6,216,025) in view of Bae et al. (US Pub. 2007/0140541 A1).

Whether claims 10-12 and 14-15 are unpatentable under 35 U.S.C. 103(a) over Kruger (USP 6,216,025) in view of Bae et al. (US Pub. 2007/0140541 A1), and further in view of Ben-Haim et al. (US Pub. 2002/0065455 A1).

Whether claims 20, 21, and 23 are unpatentable under 35 U.S.C. 103(a) over Kruger (USP 6,216,025) in view of Bae et al. (US Pub. 2007/0140541 A1), and further in view of Ben-Haim et al. (US Pub. 2002/0065455 A1).

Whether claim 22 is unpatentable under 35 U.S.C. 103(a) over Kruger (USP 6,216,025) in view of Bae et al. (US Pub. 2007/0140541 A1), further in view of Ben-Haim et al. (US Pub. 2002/0065455 A1), and further in view of Maas, III (USP 6,181,832).

7. **ARGUMENTS**

Rejection under 35 U.S.C. § 103 as being obvious by Kruger (USP 6,216,025) in view of Bae et al. (US Pub. 2007/0140541 A1)

Claims 1, 13, and 24

The Examiner rejected claims 1, 13, and 24 under 35 U.S.C. 103(a) as being unpatentable over Kruger in view of Bae et al. However, Kruger in view of Bae et al. do

not suggest or render obvious that called for in claims 1, 13, and 24. As an example, Kruger and Bae et al. do not suggest or render obvious, alone or in combination, determining a second set of TCT data from a first set of TCT data for a second inadmissible measurement surface, and reconstructing an image of an imaging object based on the first set and the second set of TCT data as called for in claim 1. As another example, Kruger in view of Bae et al. do not suggest or render obvious, alone or in combination, a computer programmed to derive, from acquired data, unacquired data for the imaging object for one or more locations inadmissible for sensor positioning due to a positioning of the imaging object as called for in claim 13. As another example, Kruger in view of Bae et al. do not suggest or render obvious, alone or in combination, deriving a second TCT dataset from a first TCT dataset, the second TCT dataset including data for transducer locations mirrored from the first set of transducer locations, and generating an image using at least the second TCT dataset as called for in claim 24.

Rejection under 35 U.S.C. § 103

The Examiner relied on Kruger for teaching a number of elements that include projecting high frequency energy toward a breast to induce thermal expansion, the breast positioned inside a hemispherical shaped imaging tank to detect a tumor in the breast. *Office Action*, 11/25/09, pg. 4. The Examiner also relied on Kruger for teaching recording of signals by transducer elements “by means of one or more sensors placed along an external surface of [a] tank (Fig. 2, Item 33)” and “generating a first TCT dataset from the ultrasonic emissions (Fig. 12A, Item 92).” *Id.*, pg. 5.

The Examiner admitted that Kruger “may” not teach creating a second set of TCT data, and relied on Bae et al. therefor. *Id.* “[I]n the field of tissue imaging and reconstruction, Bae et al. teach interpolating imaging data from acquired imaging data (para [0054]).” *Id.* “Furthermore, Bae et al. also teach that the interpolation process being involved for areas that that cannot be accessed by the by the CT imager (the finer-resolution slices were not able to be generated by the imager for reasons such as time constraints, imaging capacity, or other technology limitations.” *Id.* “The areas can thereby be considered non-accessible.” *Id.* The Examiner concluded, “[I]t would have been obvious to a person of ordinary skill in the art at the time of the invention to modify

Kruger to include generating a second TCT dataset image data in order to produce a higher reconstruction interval for a 3D dataset.” *Id.*

Appellant submits that the rejection of claims 1, 13, and 24 is deficient and that the art of record, alone or in combination, does not suggest or render obvious the claimed subject matter. As will be illustrated, Kruger teaches acquisition of transducer data and reconstruction therefrom, and Bae et al. teaches that finer-resolution slices of a reconstructed image can be interpolated if a reconstruction interval is too large. Bae et al. is not directed toward interpolating imaging data from acquired imaging data as asserted by the Examiner, nor is Bae et al. directed toward interpolation of data for areas that cannot be accessed by a CT imager as asserted by the Examiner. Instead, Bae et al. is directed toward interpolation of reconstructed CT image data using neighboring slice data. Bae et al. teaches that image data is used to generate a 3D volumetric set of a lung region, and if a reconstruction interval is larger than 1 mm, then finer resolution slices can be interpolated using neighboring slice information.

Thus, the combination of Kruger in view of Bae et al. does not suggest or render obvious that called for in the claims. At most, the combination teaches transducer data acquired and reconstructed (Kruger), and finer resolution images can be interpolated from the reconstructed data (Bae et al.).

Kruger

Kruger teaches “methods and apparatus for measuring and characterizing the localized wave absorption properties of biologic tissues in vivo, using incident electromagnetic waves to produce resultant acoustic waves.” *Kruger*, Abstract. Kruger teaches specific arrangements of multiple transducers on a rotatable imaging bowl for measuring acoustic waves produced in tissue when the tissue is exposed to electromagnetic radiation. *Id.* Kruger describes acoustic shielding techniques to minimize stray echoes and sources of noise, techniques for cancelling noise, modulation of the time between imaging pulses to randomize the effect of acoustic echoes, and a filtering technique applied to compensate for the frequency response of the transducers. *Id.*, Col. 3., Ins. 15-26. “An array of sixty-four acoustic transducers 33 is located within imaging bowl 14 in tank 16 [sic].” *Id.*, Col. 6, Ins. 1-2. The transducers should be evenly

spaced across the array, and are positioned in connection to Fig. 6. *Id.*, Col. 6, lns. 3-5. “The breast 29 of the patient is positioned as shown in FIG. 2 so that it is coupled by [the] media 18 in [the] tank to the acoustic sensors of [the] imaging bowl.” *Id.*, lns. 38-41. “After sonic pressure waves are recorded using the transducers and electronics described above, photoacoustic imaging must be ‘reconstructed’ from multiple pressure signals.” *Id.*, Col. 10, lns. 15-18. “The aim is to reconstruct some property of the breast from an ensemble of pressure measurements made externally to the breast.” *Id.*, lns. 18-20.

Thus, Kruger teaches arrangements of transducers and techniques for measuring acoustic waves in tissue when the tissue is exposed to electromagnetic radiation. The transducers are positioned across an array that is located within an imaging bowl, a breast is positioned in the bowl during imaging thereof, transducer data is acquired, and an image is reconstructed from the acquired data.

Bae et al.

Bae et al. is directed toward a method and apparatus for automated detection of target structures from medical images using a 3D morphological matching algorithm. *Bae et al.*, Title. “A method for the detection of target structures shown in digital medical images, the method of comprising: (1) generating a three dimensional (3D) volumetric data set of a patient region within which the target structure resides from a plurality of segmented medical image slices; (2) grouping contiguous structures that are depicted in the 3D volumetric data set to create corresponding grouped structure data sets; (3) assigning each grouped structure data set to one of a plurality of detection algorithms, each detection algorithm being configured to detect a different type of target structure; and (4) processing each grouped structure data set according to its assigned detection algorithm to thereby detect whether any target structures are present in the medical images. *Id.* Abstract. “[T]he present invention relates to the application of CAD techniques to CT images to thereby automate the detection of target structures such as pulmonary nodules.” *Id.* Para. [0002].

“FIG. 2 illustrates the preferred algorithm of the present invention.” *Id.*, Para. [0031]. In general, that taught in FIG. 2 is directed toward image data in a 2D realm (slice by slice) and a 3D (volumetric) realm, and “a method for the automated lung

nodule detection from CT images.” *Id.*, Para. [0031] and FIG. 2. “At step 100, CT images are generated by a scanner and received by a workstation executing software that implements the present invention.” *Id.*, Para. [0033] and FIG. 2. “The thorax’s representation in CT image slices can be easily delineated from background air because of its high tissue-to-air contrast ratio.” *Id.*, Para. [0034]. “For this same reason, the lung’s representation in the CT image slices can also be distinctly separated from its surrounding soft tissues or bony tissues.” *Id.* Bae et al. describes determining threshold values using a variety of techniques to segment the thorax and lung region at step 104. *Id.*, Para. [0035]. FIG. 3 illustrates results of lung region segmentation including lung boundary refinement. *Id.*, Para. [0037]. “Once the boundary of the lung region has been refined, the 2D segmented lung regions are stacked to generate a 3D volumetric data set of the lung region (step 108).” *Id.*, Para. [0038]. Steps 110 through 122 further describe steps that relate to image manipulation, resulting in identification of lung nodules. *Id.*, Paras. [0039] through [0052] and FIG. 2.

FIG. 7 of Bae et al. “plots a comparison of the number of nodules detected by the preferred embodiment.” *Id.*, Para. [0053]. “However, the present inventors envision that [the] processing time can be reduced through improvements in software coding.” *Id.* At the location cited by the Examiner, Para. [0054], Bae et al. describes an interpolation scheme that is related to selecting a finer resolution reconstruction interval. Bae et al. teaches that “[t]he preferred slice thickness and reconstruction interval for the CT slices is 1 mm or less.” *Bae et al.*, Para. [0054]. “After the boundary of the lung region is refined as described above in connection with FIG. 2, the 2D segmented lung regions can be stacked to generate a 3D volumetric data set of the lung region.” *Id.* “If the reconstruction interval is larger than 1 mm, finer-resolution slices can be interpolated at every 1 mm using the slice neighboring above and the slice neighboring below and integrated into the expanded 3D volumetric dataset.” *Id.*

Thus, Bae et al. teaches generation of CT images for the purpose of lung nodule identification. Bae et al. teaches that, if a reconstruction interval is too large, a finer resolution slice can be interpolated from neighboring slices.

Combination of Kruger and Bae et al.

The combination of Kruger and Bae et al. does not suggest or render the claimed subject matter obvious. Kruger teaches arrangements of transducers and techniques for measuring acoustic waves in tissue when the tissue is exposed to electromagnetic radiation. Imaging data is acquired and an image is reconstructed therefrom. Bae et al. teaches refinement of a reconstruction interval, and interpolation of reconstructed CT image data. Thus, in combination, Kruger and Bae et al. at most teach a system having an array of transducers, acquiring imaging data therewith, and reconstructing an image (Kruger); and the image may be reconstructed on a smaller reconstruction interval by interpolating neighboring slice data (Bae et al.).

Thus, Kruger teaches obtaining data at an array of locations surrounding the breast and reconstructing an image, and Bae et al. is directed toward refinement of a reconstruction interval, and interpolation of reconstructed CT image data. This is in contrast to the claimed subject matter. The claims call for determining a second set of data from a first set of data, which is done prior to image reconstruction. For example, claim 1 calls for determining a second set of TCT data from a first set of TCT data for a second inadmissible measurement surface, and reconstructing an image of an imaging object based on the first set and the second set of TCT data. As another example, claim 24 calls for deriving a second TCT dataset from a first TCT dataset, the second TCT dataset including data for transducer locations mirrored from the first set of transducer locations, and generating an image using at least the second TCT dataset.

This is also in contrast to that called for in claim 13, which calls for a computer programmed to derive, from acquired data, unacquired data for an imaging object for one or more locations inadmissible for sensor positioning due to a positioning of the imaging object.

The combined system of Kruger and Bae et al., on the other hand, includes acquisition and reconstruction, and if the reconstruction interval is too large, a smaller reconstruction interval may be selected. In fact, Bae et al. starts with CT images and proceeds from there. This is evident at Para. [0033] as cited above, where the first step in the preferred algorithm at step 100 is, “CT images are generated by a scanner and received by a workstation executing software that implements the present invention.” *Id.*,

Para. [0033] and FIG. 2. Thus, Bae et al. is not directed toward manipulation of data prior to image reconstruction, but begins with CT images, and interpolation therebetween to reduce a reconstruction interval. In other words, Kruger and Bae et al. combine in a linear fashion, in that Kruger teaches acquisition of data and reconstruction thereof, and Bae et al. teaches refinement of the reconstruction interval. This is in contrast to the claimed subject matter of specifically claims 1 and 24 that calls for acquiring a first set of data and then determining or deriving a second set of data therefrom prior to image reconstruction. This is also in contrast with claim 13 that calls for a computer programmed to derive, from acquired data, unacquired data for an imaging object for one or more locations inadmissible for sensor positioning due to a positioning of the imaging object.

The Examiner relied on Bae et al. for teaching interpolation of data, but read beyond that teaching to find a determination that the data interpolated in Bae et al. is related to “non-accessible” transducer locations. However, Bae et al. in combination with Kruger does not teach or suggest to one skilled in the art that the interpolation of data has to do with sensor locations that cannot be accessed, or “inadmissible” or “mirrored” as called for in the claims. Further, Bae et al. in combination with Kruger does not teach or suggest to one skilled in the art to reconstruct an image using acquired image data and a second set of data determined or derived therefrom for image reconstruction. At most, Kruger teaches reconstruction of an image using TCT data obtained about the breast, and if the reconstruction interval is too great, Bae et al. would teach using a smaller reconstruction interval. This is not tantamount to determining data at “non-accessible” transducer locations via the interpolation method of Bae et al.

Thus, Kruger and Bae et al. do not suggest or render obvious, alone or in combination, determining a second set of TCT data from a first set of TCT data for a second inadmissible measurement surface, and reconstructing of an image of an imaging object based on the first set and the second set of TCT data as called for in claim 1. As another example, Kruger and Bae et al. do not suggest or render obvious, alone or in combination, a computer programmed to derive, from the acquired data, unacquired data for the imaging object for one or more locations inadmissible for sensor positioning due to a positioning of the imaging object as called for in claim 13. As another example,

Kruger and Bae et al. do not suggest or render obvious, alone or in combination, deriving a second TCT dataset from a first TCT dataset, the second TCT dataset including data for transducer locations mirrored from the first set of transducer locations, and generating an image using at least the second TCT dataset as called for in claim 24. Clearly, these are steps that are not suggested or rendered obvious in the art of record.

As such, Appellant respectfully submits that Kruger and Bae et al., alone or in combination, do not suggest or render obvious that called for in claims 1, 13, and 24.

Advisory Action of February 2, 2010

In an Advisory Action dated February 2, 2010, the Examiner set forth a number of allegations. *Advisory Action*, 02/02/10, pg. 2. In the Advisory Action, the Examiner stated, “Furthermore, none of the independent claims of the instant application explicitly recite the word ‘extrapolation’, so any arguments attempting to distinguish between the concepts of interpolation and extrapolation would not result in an allowable claim even if Applicants are assumed to be correct.” *Advisory Action*, 02/02/10, pg. 2. Appellant has not argued that any of the claims recite “extrapolation.” Rather, Appellant merely submits that the terms “extrapolation” and “interpolation” are not as readily interchangeable as alleged by the Examiner as used in the rejections of the claims.

Nevertheless, even if such were the case, Appellant submits that the combination of Kruger with Bae et al. would not suggest or render the claimed subject matter obvious. That is, generation of data between two neighboring slices of imaging data fails to teach or suggest, for example, determining a second set of TCT data from a first set of TCT data for a second inadmissible measurement surface, and reconstructing of an image of an imaging object based on the first set and the second set of TCT data as called for in claim 1; a computer programmed to derive, from the acquired data, unacquired data for the imaging object for one or more locations inadmissible for sensor positioning due to a positioning of the imaging object; and deriving a second TCT dataset from a first TCT dataset, the second TCT dataset including data for transducer locations mirrored from the first set of transducer locations, and generating an image using at least the second TCT dataset.

Conclusion – claims 1, 13, 24

The combination of Kruger with Bae et al. teaches, at most, that data may be obtained by first measuring breast imaging data at 64 transducer locations, reconstructing the image data, and then interpolating reconstructed data using that taught in Bae et al. The art of record does not suggest or render obvious determining a second set of TCT data from a first set of TCT data for a second inadmissible measurement surface, and reconstructing an image of an imaging object based on the first set and the second set of TCT data as called for in claim 1. As another example, the art of record does not suggest or render obvious, alone or in combination, a computer programmed to derive, from the acquired data, unacquired data for the imaging object for one or more locations inadmissible for sensor positioning due to a positioning of the imaging object as called for in claim 13. As another example, the art of record does not suggest or render obvious, alone or in combination, deriving a second TCT dataset from a first TCT dataset, the second TCT dataset including data for transducer locations mirrored from the first set of transducer locations, and generating an image using at least the second TCT dataset as called for in claim 24.

Thus, that called for in claims 1, 13, and 24 is neither taught nor suggested in Kruger, Bae et al., or a combination thereof. Accordingly, Appellant believes that claims 1, 13, and 24 are patentable over the art of record.

Claims 2, 5-13, 15-19, and 25-26.

Claims 2, 5-9, 16-19, and 25 were rejected as unpatentable under 35 U.S.C. 103(a) over Kruger (USP 6,216,025) in view of Bae et al. (US Pub. 2007/0140541 A1). Claims 10-12 and 15 were rejected as unpatentable under 35 U.S.C. 103(a) over Kruger (USP 6,216,025) in view of Bae et al. (US Pub. 2007/0140541 A1), and further in view of Ben-Haim et al. (US Pub. 2002/0065455 A1).

By virtue of their dependence from what are otherwise believed to be allowable claims, Appellant submits that claims 2, 5-13, 15-19, and 25-26, likewise, are not suggested or rendered obvious, and Appellant requests withdrawal of the rejections thereof.

Rejection under 35 U.S.C. § 103 as being obvious by Kruger (USP 6,216,025) in view of Bae et al. (US Pub. 2007/0140541 A1), and further in view of Ben-Haim et al.

Claim 20

Claim 20 was rejected under 35 U.S.C. §103(a) as being unpatentable over Kruger in view of Bae et al., and further in view of Ben-Haim et al. However, Kruger in view of Bae et al., and further in view of Ben-Haim et al. does not suggest or render obvious that called for in claim 20. As an example, Kruger in view of Bae et al., and further in view of Ben-Haim et al. do not suggest or render obvious, alone or in combination, a computer readable storage medium having a computer program stored thereon and representing a set of instructions that when executed by a computer causes the computer to determine coefficients of a polynomial expression that is relative to a position of a transducer about an imaging object, acquire thermoacoustic computed tomography (TCT) data from the imaging object, and from the coefficients, determine TCT data corresponding to a desirable transducer location about the imaging object that is inadmissible to a TCT transducer as called for in claim 20.

Kruger and Bae et al. are summarized above.

The Examiner relied on Ben-Haim et al. for teaching the use of a Legendre Polynomial. Referring to claim 20, Appellant interprets that the Examiner also relied on Ben-Haim et al. for teaching the determination of coefficients of a polynomial expression.

Ben-Haim et al. teaches a locating system for determining the location and orientation of an invasive medical instrument relative to a reference frame. *Ben-Haim et al.*, Abstract. The position and orientation of a distal end of a catheter are ascertained by use of two or three antennas, such as radiators 18, 20, and 22. *Id.*, Para. 103. The three radiators are driven by a radiator driver 24 and, along with a signal processor 26, provide “a display or other indication of the position and orientation of the distal end 15 on a monitor 27.” *Id.*, Par. 105. “[T]he field equations are derived specifically for each embodiment and are dependent on the geometry and characteristics of the radiators.” *Id.*, Par. 147. In the preferred embodiment where the radiators are coils, for a coil with N turns, radius R, and current I, a series of vector equations are generated wherein a radial

and tangential component are described. *Id.*, Pars. 147-148. The tangential component includes an expression, $P_n(x)$, which is a Legendre Polynomial of degree n which may be calculated recursively through the method described. *Id.*, Pars. 149-153. Thus, the field sensed by a remote sensor results in equations having known and unknown variables for any given coil. *Id.*, Pars. 154-155. In the embodiment having three sensors, the technique described results in an overdetermined series of nine equations and six variables and, with nine sensor readings, the unknowns may be numerically solved for by using, for instance, a Newton-Raphson method for non-linear systems, and “[t]he location sensor position and orientation are displayed on monitor 27.” *Id.*, Pars. 158-159.

Thus, Ben-Haim et al. describes obtaining a location and orientation of an invasive medical instrument using a numerical solution that includes a Legendre Polynomial. However, such is not tantamount to rendering obvious the claimed subject matter. That is, determining a position of an instrument in an actual position does not teach or suggest determining an inadmissible location of the instrument. Ben-Haim et al. also fails to teach or suggest that coefficients of a polynomial expression such as the Legendre Polynomial are used to determine data corresponding to a location of the instrument that is inadmissible to the instrument. Thus it is unclear why one skilled in the art would look to Ben Haim et al. to determine such coefficients for the purpose of determining TCT data that is inadmissible to a TCT transducer. In fact, it is unclear why one skilled in the art would think it obvious to look to Ben Haim et al. at all to find an instrument where one is not located.

As such, Ben-Haim et al. does not teach or suggest determining TCT data corresponding to a transducer location about the imaging object not accessible to a TCT transducer. Thus, Kruger, Bae et al., or Ben-Haim et al., alone or in combination, do not teach or suggest that called for in claim 20. Although Ben-Haim et al. describes the use of a Legendre Polynomial, Ben-Haim et al. does so for reasons that do not make the claimed subject matter obvious, as Ben-Haim et al. is directed toward determining a location of an instrument. Thus, at most, a combination of Kruger, Bae et al., and Ben-Haim results in a system that obtains data by measuring breast imaging data at 64 transducer locations, reconstructing the image data, and then interpolating reconstructed

data. The combined system also uses a Legendre Polynomial to determine a location of an existing instrument.

Kruger, Bae et al., Ben-Haim et al., or a combination thereof do not suggest or render obvious a computer caused to determine TCT data corresponding to a desirable transducer location about the imaging object that is inadmissible to a TCT transducer.

Thus, that called for in claim 20 is neither taught nor suggested in Kruger, Bae et al., Ben-Haim et al., or a combination thereof. Accordingly, Appellant believes that claim 20 is patentable over the art of record.

Claims 21-23

Claims 21 and 23 were rejected as unpatentable under 35 U.S.C. 103(a) over Kruger (USP 6,216,025) in view of Bae et al. (US Pub. 2007/0140541 A1), and further in view of Ben-Haim et al. (US Pub. 2002/0065455 A1).

Claim 22 was rejected as unpatentable under 35 U.S.C. 103(a) over Kruger (USP 6,216,025) in view of Bae et al. (US Pub. 2007/0140541 A1), further in view of Ben-Haim et al. (US Pub. 2002/0065455 A1), and further in view of Maas, III (USP 6,181,832).

By virtue of their dependence from what are otherwise believed to be allowable claims, Appellant submits that claims 21-23, likewise, are not suggested or rendered obvious, and Appellant requests withdrawal of the rejections thereof.

8. **CONCLUSION**

For at least the reasons set forth above, that which is called for in claims 1, 2, and 4-26 is not suggested or rendered obvious in the art of record or a combination thereof.

As such, Appellant believes that claims 1, 2, and 4-26, and claims which depend therefrom, are patentably distinct over the art of record.

Appellant appreciates the Board's consideration of these Remarks and respectfully requests timely issuance of a Notice of Allowance.

Respectfully submitted,

/Kent L. Baker/

Kent L. Baker
Registration No. 52,584
Phone 262-268-8100
klb@zpspatents.com

Respectfully submitted,

/Paul M. Ratzmann/

Paul M. Ratzmann
Registration No. 62,592
Phone 262-268-8100 ext. 16
pmr@zpspatents.com

Dated: April 26, 2010
Attorney Docket No.: GEMS8081.195

P.O. ADDRESS:

Ziolkowski Patent Solutions Group, SC
136 South Wisconsin Street
Port Washington, WI 53074
262-268-8100

CLAIMS APPENDIX

1. (Previously Presented) A method of diagnostic imaging comprising the steps of:

acquiring a first set of thermoacoustic computed tomography (TCT) data from a measurement surface of an imaging object;

determining a second set of TCT data from the first set of TCT data for a second inadmissible measurement surface; and

reconstructing an image of the imaging object based on the first set and the second set of TCT data.

2. (Original) The method of claim 1 wherein the step of determining includes the step of extrapolating the second set of TCT data from the first set of TCT data.

3. (Canceled)

4. (Original) The method of claim 1 further comprising the step of supplementing the first set of data with the second set of TCT data such that shading in an image of the portion of the imaging object is reduced.

5. (Original) The method of claim 1 further comprising the step of impulsively in time, uniformly in space applying RF energy to the imaging object to induce thermal expansion of the imaging object for TCT data acquisition.

6. (Original) The method of claim 1 further comprising the step of periodically in time & uniformly in space applying RF energy to the imaging object to induce thermal expansion of the imaging object for TCT data acquisition.

7. (Original) The method of claim 1 further comprising the step of impulsively in time & selectively in space applying RF energy to the imaging object to induce thermal expansion of the imaging object for TCT data acquisition.

8. (Original) The method of claim 1 further comprising the step of periodically in time & selectively in space applying RF energy to the imaging object to induce thermal expansion of the imaging object for TCT data acquisition.

9. (Original) The method of claim 1 further comprising the step of acquiring the first set of TCT data from a plurality ultrasonic transducers positioned in proximity to the imaging object.

10. (Original) The method of claim 9 further comprising the step of expanding TCT data for each transducer into a representative polynomial and using coefficients of the representative polynomial to determine the second set of TCT data.

11. (Original) The method of claim 10 wherein the representative polynomial includes a Legendre polynomial.

12. (Original) The method of claim 11 further comprising the step of determining the second set of TCT data from coefficients of even terms of the Legendre polynomial.

13. (Previously Presented) A thermoacoustic computed tomography (TCT) imaging system comprising:

an energy source configured to apply energy to an imaging object to induce thermal expansion in the imaging object;

one or more sensors positioned at one or more respective positions and configured to acquire ultrasonic data from the imaging object caused by RF energy-induced thermal expansion in the imaging object; and

a computer programmed to derive, from the acquired data, unacquired data for the imaging object for one or more locations inadmissible for sensor positioning due to a positioning of the imaging object.

14. (Original) The TCT imaging system of claim 13 wherein the computer is further programmed to derive the unacquired data by evaluating coefficients of a polynomial expression of the acquired data.

15. (Original) The TCT imaging system of claim 14 wherein the computer is further programmed to determine the polynomial expression relative to sensor position about the imaging object.

16. (Previously Presented) The TCT imaging system of claim 13 wherein the energy to induce thermal expansion includes one of RF energy, infrared energy, and near-infrared energy.

17. (Previously Presented) The TCT imaging system of claim 16 configured to determine a presence of an abnormality in breast tissue.

18. (Original) The TCT imaging system of claim 17 further comprising a hemispherical shaped imaging tank having a fluid disposed therein, the fluid having dielectric and ultrasonic properties similar to that of breast tissue.

19. (Original) The TCT imaging system of claim 18 wherein the one or more sensors are placed along an external surface of the hemispherical shaped tank.

20. (Previously Presented) A computer readable storage medium having a computer program stored thereon and representing a set of instructions that when executed by a computer causes the computer to:

determine coefficients of a polynomial expression that is relative to a position of a transducer about an imaging object;

acquire thermoacoustic computed tomography (TCT) data from the imaging object;

from the coefficients, determine TCT data corresponding to a desirable transducer location about the imaging object that is inadmissible to a TCT transducer; and

generate an image using at least the TCT data determined from the coefficients.

21. (Original) The computer readable storage medium of claim 20 wherein the set of instructions further causes the computer to impose consistency conditions on acquired TCT data such that coefficients of even terms of the polynomial expression are evaluatable to determine TCT data corresponding to the desirable transducer locations.

22. (Original) The computer readable storage medium of claim 20 wherein the set of instructions further causes the computer to reduce partial scan artifacts in acquired TCT data.

23. (Original) The computer readable storage medium of claim 20 wherein the polynomial expression is a Legendre polynomial.

24. (Previously Presented) A method of imaging a breast comprising the steps of:

projecting high frequency energy toward a breast to induce thermal expansion of tissue in the breast;

receiving ultrasonic emissions at a first set of transducer locations from a first portion of the breast resulting from the thermal expansion;

generating a first thermoacoustic computed tomography (TCT) dataset from the ultrasonic emissions;

deriving a second TCT dataset from the first TCT dataset, the second TCT dataset including data for transducer locations mirrored from the first set of transducer locations; and

generating an image using at least the second TCT dataset.

25. (Original) The method of claim 24 wherein the second TCT dataset corresponds to a second portion of the breast from which ultrasonic emissions were not directly received.

26. (Original) The method of claim 24 wherein the high frequency energy includes one of RF, infrared, and near-infrared energy.

EVIDENCE APPENDIX:

-- None --

RELATED PROCEEDINGS APPENDIX:

-- None --